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COSTS OF HAY CONDITIONING for FASTER FIELD CURING

C. V. MOORE :: J. H. SITTERLEY :: E. T. SHAUDYS

OHIO AGRICULTURAL EXPERIMENT STATION
Wooster, Ohio

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COSTS OF HAY CONDITIONING FOR FASTER FIELD CURING [1]

C. V. MOORE, J. H. SITTERLEY and E. T. SHAUDYS

Farmers have always been interested in methods of improving the quality of forages. Forage crops have a more predominate role with increased use of soil conservation practices and government restrictions on grain crop acreages.

Quality and yield of the forage crops are sensitive to weather conditions at harvest time. Many harvesting methods have been tried to reduce weather risk. Some farmers harvest forages as grass silage, others as mow dried hay, while others field condition hay.

An analysis by Bere[2] of June climatic conditions during the 15-year period, 1938-1952, disclosed an average of 3.1 periods with three or more consecutive good drying days. Climatic conditions were such that hay cut on the first day could have been stored on the afternoon of the third day (the time assumed for unaided field curing to occur). In four years out of the 15, the favorable drying periods during June were found to be one or less.

There was an average of six two-day periods, with good hay drying conditions, if curing could be accelerated, permitting storage on the second afternoon rather than the third.

Quality losses occur because of: (1) shattering of leaves and other fine parts, (2) fermentation and bleaching of plant nutrients, and (3) leaching of soluble plant nutrients from exposure. Losses in quantity have been experienced when continued bad weather prevented getting on the fields with harvesting equipment or when continued rains caused hay to rot in the field, before it could be taken up.

Hay conditioners reduce field curing time, permitting farmers to take advantage of two-day field curing periods. When this is done, periods available for field curing hay, without rain, increased by more than 75 percent.

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[1]Based on data assembled and presented as an unpublished Masters Thesis entitled, "The Cost of Operation and Farmer Experience in the Use of the Hay Conditioner on Selected Central Ohio Farms, 1957", by James D. Utzinger, The Ohio State University, 1958.

[2]Bere, R. L., "The Effect of Climatological Factors on the Time Available to do Selected Farming Operations in Central Ohio", unpublished Masters Thesis, Ohio State University, 1953.

Objectives

There were three primary objectives to this study: (1) To determine the cost of owning and operating hay conditioners in central Ohio. (2) To determine operational problems encountered in the use of these machines. (3) To determine what acreage of hay is required to justify the purchase of a hay conditioner.

For this study 26 central Ohio farmers owning hay conditioners were interviewed. The hay conditioner was a relatively new innovation and few were in use, thus most of the owners in the area were included. Owners' names were obtained from equipment dealers and other farmers. Interviews were conducted during September, 1957.

All farmers interviewed raised forage consuming livestock. Ten had a dairy enterprise and 16 a beef enterprise. The farms ranged in size from 88 to 1500 acres, averaging 451 acres.

The 26 machines were used to condition 3697 acres of hay during 1957, or an average of 142 acres. Of the 3697 acres conditioned, 1930 were first cutting hay, 1210 were second cutting hay and 557 were third cutting hay.

Twenty-five farmers baled the conditioned hay, and one farmer used a chopper.

METHODS OF CONDITIONING

Two general types of machines were used: crushers and crimpers. Both types break the stems, permitting moisture within the plant to escape from a larger surface area. Thick juicy stems dry at nearly the same rate as the leaves, allowing the entire plant to dry faster and more uniformly.

Both crimper and crusher type conditioners are now available with and without mowers. The crusher type conditioners included in this study were all mower combination units. Eighteen of the crimpers were separate units. Two crimpers, not included in the cost analysis, were used in combination with mowers.

Mower–Crusher

The six mower-crusher conditioners pressed the stems between two smooth steel rollers. Only one man and one tractor were necessary for mowing and conditioning with this machine. The crusher unit was disengaged and the mower unit operated on the first round. On the second round, the crusher was engaged and the first swath was conditioned while a new swath was being cut.

Crimper

The crimper employed corrugated steel rollers, kinking the stem every two or three inches. Usually two men and two tractors were used for the mowing and conditioning operations. One man would do the mowing, the second following a few minutes later with the crimper. One farmer used one one man and one tractor, first mowing a few acres, then unhitching the mower and attaching the crimper to condition the hay just cut.

Most farmers interviewed stated that a 2-plow tractor furnished sufficient power to operate either type conditioner. However, a 3-plow tractor was considered necessary on hilly or soft fields.

Rate of Accomplishment

There was considerable variation in the rate of conditioning hay. For first cutting hay, the crimper operators conditioned 1¾ to 3¾ acres per hour, averaging 2¾ acres per hour. Mower-crusher operators conditioner 1¾ to 2½ acres per hour, averaging 2 1/3 acres per hour. The average rate of conditioning for both types was a little greater on second and third cuttings.

Operational Problems

Moisture—Hay wrapping on the rolls was reported, by farmers, when the moisture content of the hay dropped too low. Equipment manufacturers state that the critical moisture level is 65 percent, and recommend the conditioning operation be completed before the moisture drops to this level.

Twisted or Bunched Swath—Removal of the swath board helped to eliminate the tendency of hay to wrap around the rollers when the mower had piled up or twisted the swath.

Tension—Wrapping trouble was encountered by a few operators until the correct adjustment of the spring tension or spacing of the rollers was achieved. Heavy crops of hay generally require more tension than light crops.

Operating Speed—Wrapping troubles also were reported when the power take-off speed was too slow. This happened when slowing down for turns or when going over rough spots.

EFFECT OF HAY CONDITIONERS ON CURING TIME

Farmers were asked to report curing time for conditioned and unconditioned hay. Answers were based on past experience with unconditioned hay as compared to current experiences with conditioned hay. Weather conditions and hay yields were not necessarily the same.

TABLE 1.—Number of Farmers Reporting Curing Time by Days and Cutting for Unconditioned and Conditioned Hay, 26 Central Ohio Farms, 1957

Days of curing (including day cut)	Hay Crop					
	First		Second		Third	
	Unconditioned	Conditioned	Unconditioned	Conditioned	Unconditioned	Conditioned
2	1	13	4	19	4	15
3	6	9	7	3	5	2
4	10	0	8	0	5	0
5	3	0	2	0	2	0
No response	6	4	5	4	10	9

More variation was reported, in curing time, for unconditioned hay than for conditioned hay. Over half stored first cutting and more than three-fourths, of the farmers, stored second and third cutting conditioned hay the day after cutting.

Two of the 26 farmers experienced no reduction in curing time on first cutting hay. Eleven operators reported a one-day reduction in curing time. Five of these 11 farmers usually stored unconditioned hay on the third day, including the day cut, and six on the fourth day. Five other operators reported a 2-day reduction in curing time, between unconditioned hay and conditioned hay. Three of these normally stored unconditioned hay on the fourth day and two on the fifth day. One farmer observing a 3-day reduction in curing time said he normally stored unconditioned hay on the fifth day.

Similar results were found for the second and third cutting hay. Operators reporting more than a 1-day reduction, in curing time, when a conditioner was used, allowed more than the normal amount of time for curing unconditioned hay.

Results from Other States

A Wisconsin study indicated the greatest gains in drying rates were realized with very good drying conditions. A one-day decrease, in curing time, with good drying conditions early in July was realized when a conditioner was used.[3] The advantage of conditioning diminished with poorer drying conditions.

[3]Brahn, A. D. **Forage Crushers.** Wisconsin Agricultural Experiment Station Bulletin 514. May, 1955.

TABLE 2.—Hours of Drying Time for Crushed and Uncrushed Hay by Kind of Hay, Illinois, 1952

Kind of hay	Hours Drying Time	
	Crushed	Uncrushed
Alfalfa—First cut	25 3	52.3
Alfalfa—Second cut	23 6	45.3
Red Clover	23 3	45.3
Soybean Hay	49.9	127.0

Source: Rameer and Kleis, University of Illinois Circular 693, "Hay Crushing for Faster Field Curing," June, 1952.

Research in Illinois indicated similar reductions in drying time as indicated by the hours required to cure conditioned and unconditioned hay (Table 2).

Crimper

Fixed Costs—The purchase price of crimper type conditioners average $751 and ranged from $625 to $840. This investment would be spread over the life of the machine in the form of depreciation. Factors affecting the useful life of the machine include: (1) the amount of use, (2) operating conditions, (3) the care given, and (4) obsolescence. Most conditioner owners estimated machine life at 10 years, obsolescence being an important consideration. Fixed costs include: depreciation, insurance, taxes, interest, and housing. These averaged $108 annually (Table 3).

Variable costs of operating a hay conditioner consisted of power, labor and repair charges. A charge of $1.10 per hour was made for the tractor and $1.00 per hour for labor. Repair costs, based on experience with similar machines, were estimated at 16¢ per hour.[4] Variable costs per acre remain the same regardless of the size of job done. These averaged 84¢ per acre.

Total costs for mowing and conditioning averaged $1.74 per acre for the 18 crimper units on 120 acres. Cost of conditioning ranged from $1.20 per acre for 300 acres to $4.43 for 30 acres.

[4]Repair costs estimated at 25 percent of purchase price spread over a 1200 hour life.

TABLE 3.—Costs of Conditioning 120 Acres with a Hay Crimper, 18 Central Ohio Farms, 1957

Item	Cost	
	Annual	Per Acre
Fixed costs		
Depreciation (10-year life)	$ 75.13	$ .63
Insurance (38 cents per $100 on 80 percent)	2.40	.02
Taxes ($2.00 per $100 on 50 percent)	3.77	.03
Interest (6 percent on midvalue)	22.54	.19
Housing (1 percent on midvalue)	3.76	.03
Total	$107.60	$ .90
Variable costs*		
Tractor	$ 49.20	$ .41
Labor	44.40	.37
Repairs	7.20	.06
Total	$100.80	$ .84
Total cost	$208.40	$1.74

Note: Two farms using crimpers with special hookup attachments were not included in the cost section of this study.

*Rate of accomplishment, .37 hours per acre.

Mower–Crusher

Fixed Costs—The average investment for the six mower-crusher type conditioners was $1257 and ranged from $1050 to $1500. A straight line depreciation for a 10-year machine life was used. Other fixed costs included: insurance, taxes, interest on investment and housing. These, with depreciation, averaged $179 per farm and 90¢ per acre for the 199 acres conditioned by the average machine (Table 4).

Variable Costs—A higher rate, $1.25 per hour, was charged for power because of greater draft for these units. Labor was charged at $1.00 per hour. Drawing on experience with similar type machines, a repair cost of 35¢ per hour was established.[5]

[5]Two-thirds of total purchase price was charged to the crusher, one-third to the mower. Twenty-five percent of the value of crusher and 50 percent of the value of mower was spread over 1200-hour life of machine for a repair cost.

TABLE 4.—Costs of Mowing and Conditioning 199 Acres with a Mower-Crusher, 6 Central Ohio Farms, 1957

Item	Cost	
	Annual	Per Acre
Fixed costs		
Depreciation	$125.70	$ .63
Insurance	3.98	.02
Taxes	5.97	.03
Interest	37.81	.19
Housing	5.97	.03
Total	$179.43	$ .90
Variable costs*		
Tractor	101.49	.51
Labor	81.59	.41
Repairs	27.86	.14
Total	$210.94	$1.06
Total cost	$390.37	$1.96

*Rate of accomplishment, .41 hours per acre.

Total cost per acre mowed and conditioned with the six mower-crusher units averaged $1.96. These costs ranged from $1.66 for a farm with 300 acres to $2.85 per acre for a farm with 100 acres mowed and conditioned.

RETURNS REQUIRED TO JUSTIFY PURCHASE OF A HAY CONDITIONER

Important considerations that influence the decision to purchase a hay conditioner are: (1) the importance of hay to the farm operation, (2) the relative advantage of investing the capital in other enterprises and (3) the extent to which higher quality hay would either increase livestock production, reduce feed costs or increase the sale price of hay.

Crimper Type Conditioner

For the purpose of analysis, costs at three levels of use for the crimper type conditioner were established using an average annual fixed cost of $108 per machine. Level A, three cuttings of 16.7 acres each or 50 acres conditioned, level B, three cuttings of 41.7 acres each or 125

acres, and level C, three cuttings of 66.7 acres each or 200 acres. The fixed costs per acre conditioned were $2.16 for level A, 86¢ for level B and 54¢ for level C. The variable costs per acre were 84¢ for all levels.

At level A, a farmer would need to receive returns equal to $150 (the cost of conditioning) from reduced physical loss or improved quality. Seven and one-half tons or 15 percent more hay would have to be saved than under conventional harvesting methods to offset this added cost. Average losses with conventional harvesting of this extent are unlikely. Annual loss in physical yield with conventional curing was estimated to be five percent. On 16.7 acres, this loss would be 2½ tons valued at $50.00. Assuming conditioning would eliminate this loss, $100 remain to be recovered ($150–$50 = $100). This $100 must be recovered by an increase in feeding value or sale price. On a production of 50 tons, this would equal $2.00 per ton.

The returns which must be received to cover the added cost from using a conditioner for three levels of usage are shown in Table 5.

Returns that must be made up by improved quality or increased sale price (when the assumed five percent losses not incurred), decreases as the acreage conditioned increases.

TABLE 5.—Returns Needed to Offset Hay Crimper Conditioning Costs at Three Levels of Operation, Ohio, 1957

Item	Acres (3 cuttings)		
	16.7	41.7	66.7
Yield (tons)	50	125	200
Added conditioning cost			
Total	$150	$213	$275
Per acre	3.00	1.70	1.38
Percent crop value needed to pay conditioning cost	15.0%	8.5%	6.9%
Value of estimated 5% loss eliminated by conditioning	$ 50	$125	$200
Remaining cost to be paid by quality improvement			
Total	$100	$ 88	$ 75
Per ton	$ 2.00	$ .70	$ .38

Mower-Crusher Type Conditioner

Mower-crushers performed the mowing and conditioning operations simultaneously. Mowing was not a new cost, thus an adjustment must be made to determine the added conditioning cost. The entire fixed cost of the new machine was added to the cost of harvesting hay. Since the mowing operation was performed before a conditioner was used, only the increase in variable costs could be charged. The additional conditioning variable cost was 34¢ per acre.

This was determined by subtracting the mower variable cost of 72¢ per acre from the mower-crusher variable cost of $1.06 per acre.

Costs for three similar levels of use for the mower-crusher were established using an average purchase price of $1257, with an average annual fixed cost of $180 per machine. The fixed costs per acre conditioned were $3.60 per acre for level A, $1.44 per acre for level B, and 90¢ per acre for level C. The added variable cost of conditioning per acre was 34¢ for all levels.

At level A, a farmer would need to receive returns equal to the $197 added conditioning cost from reduced physical loss or improved quality. If it were all to be recovered by an increase in the amount harvested, 10 tons or 20 percent more hay would have to be saved than

TABLE 6.—Returns Needed to Offset Mower-Crusher Hay Conditioning Cost at Three Levels of Operation, Ohio, 1957

Item	Acres (3 cuttings)		
	16.7	41.7	66.7
Yield (tons)	50	125	200
Added conditioning cost			
Total	$197	$222	$248
Per acre	3.94	1.78	1.24
Percent crop value needed to pay conditioning costs	15.0 %	8.5 %	6.9 %
Value of estimated 5 % loss eliminated by conditioning	$ 50	$125	$200
Remaining cost to be paid by quality improvement			
Total	$147	$ 97	$ 48
Per ton	$ 2.94	$ .78	$ .24

was achieved under conventional harvesting methods. Average losses of this extent are unlikely. The average loss in physical yield on the 16.7 acres was estimated at five percent worth $50. There remains $147 of the conditioning cost to be recovered ($197–$50 = $147). This $147 must be recovered by an increase in feeding value or sale price. On a production of 50 tons, this would equal $2.94 per ton (Table 6).

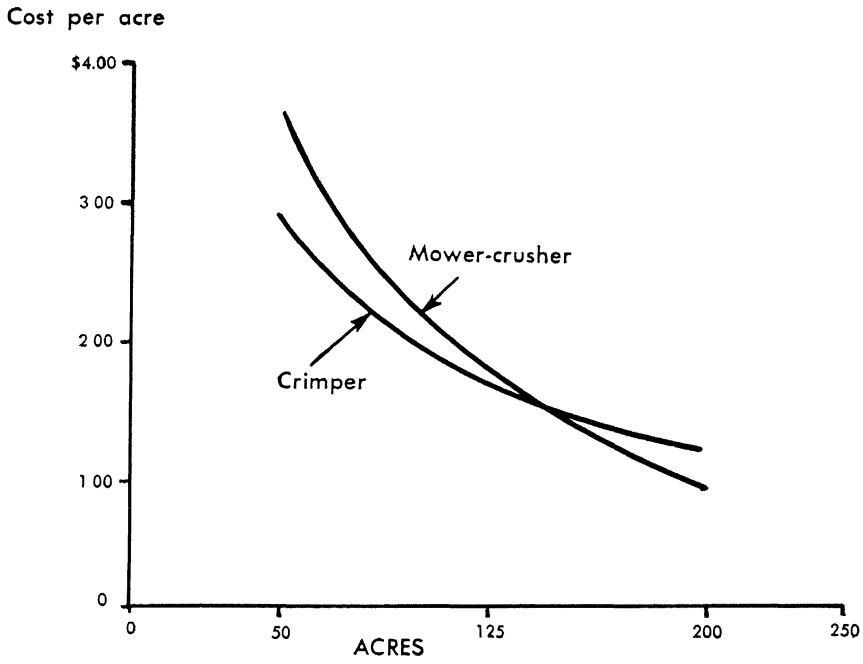

Chart 1. Additional Cost per Acre of Using Hay Conditioners, Ohio, 1957

CONCLUSIONS

Mowing and conditioning small acreages are less costly when done in separate operations than when a combination outfit is used. Mowing and conditioning simultaneously is more efficient on the larger acreages. Several factors are involved: (1) The mower-crusher has a higher fixed cost because of a large initial investment, interest, insurance, and taxes. When this charge is spread over a small acreage, the fixed cost per acre is relatively high but drops rapidly as the acreage is

increased. (2) The crimper has a lower fixed cost because of a lower initial investment, interest, insurance, and taxes. However, the crimper has a higher variable cost caused by the necessity of making two trips over the field (one trip for mowing, one trip for conditioning), This higher variable cost for the crimper results in a higher total cost per acre on larger acreages.

The mower-crusher combination machines, in this study, could not be separated and the mower used by itself. Therefore, it would be necessary to own a second mower for clipping pastures and stubble. This, in turn, would result in a higher fixed cost for these tasks than on farms where only part of the fixed cost of the mower was carried by the hay crop.

SUMMARY

Owners of hay conditioners reduced hay curing time by one day. This cut exposure time 25-30 percent and allowed them to take advantage of more periods of favorable weather. Twenty conditioner owners reported improvement in the quality of hay harvested.

Criteria for determining the desirability of purchasing a conditioner are: (1) The importance of hay to the farm operation. If hay limits the size of the livestock enterprise, then an increase in yield is very important. (2) The relative advantage of investing capital elsewhere in the farm operation. Other enterprises may pay a higher return on additional investment. (3) Reduction in feed cost is made possible by feeding high quality hay. Higher quality hay yields greater returns when fed to livestock that produce a saleable product directly, such as meat or milk, than to breeding stock such as beef brood cows. (4) Increased value if conditioned hay is sold.

Costs per acre decrease as the acreage conditioned is increased. On the larger acreages, it is possible to recover most of the added cost of conditioning through reduced yield losses. More of the added costs must be met by gains from improved quality when small acreages are harvested.